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(54) Noise reducing blade/stator assembly

(57) A fan unit primarily for a hair dryer has a fan 1 with five blades 2 of which the adjacent trailing and leading edges 3, 4 overlap with the trailing edge of a blade having a marked forward rake at the periphery as viewed in the direction of rotation. The fan is driven by a DC high speed motor 5 which is housed within the hub 6, having a plurality of outwardly extending stator vanes 7 which connect with the inner peripheral surface 8 of a shroud or body.

Vanes 7 commencing at the downstream end 10 extend generally parallel to the air flow towards the fan and thereafter curve at 11 in a direction against the rotational direction of the fan with the end of the vane being defined by an edge formed by a portion 12 which generally extends in a direction parallel to the plane of the fan. This edge extends outwardly from a hub towards the shroud in a direction which lies at an angle B against the direction of rotation (see Fig. 5) and in conjunction with the opposite angle of the trailing edge 3 of a fan blade forms an intersection which, as the fan rotates, progresses from the outer periphery of the vane and fan blade towards the hub reducing fan generated noise.

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

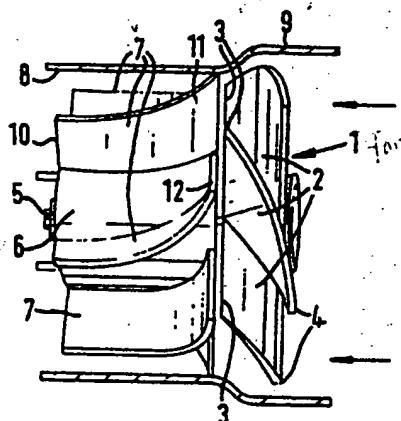


FIG.1

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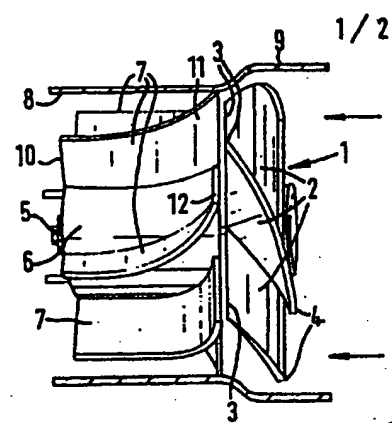


FIG. 1

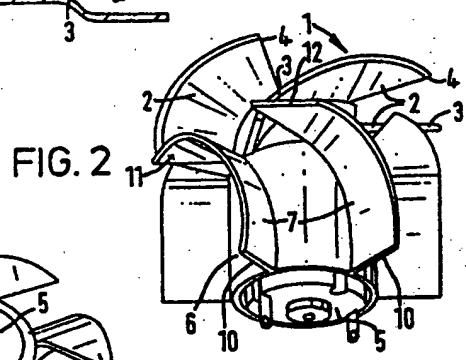


FIG. 2

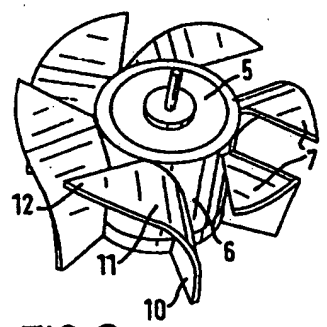


FIG. 3

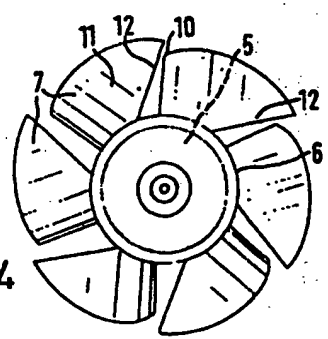
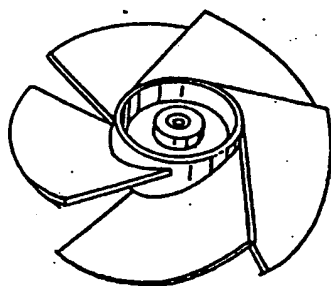
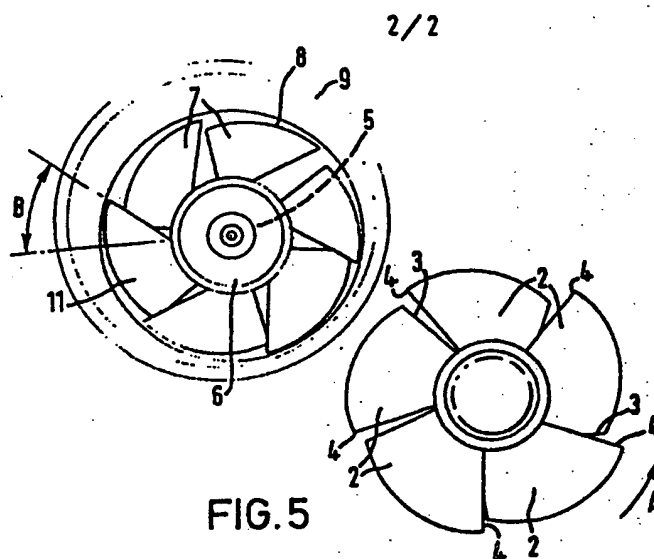


FIG. 4

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## SPECIFICATION

## Ducted fans

5 This invention relates to improvements in ducted fans and is primarily concerned with an axial air impelling fan unit used for hair drying apparatus, electric paint stripping apparatus and the like constructions of apparatus wherein a tubular body is provided at its one end with an air inlet and at its other end with an air outlet, an electrical resistance heating means and an electric motor driven fan being positioned between the inlet and outlet. Especially with hair drying apparatus fan and air noise is a serious problem aggravated by the use of low voltage high speed (up to 18,000 r.p.m.) D.C. motors driving fans of small diameter which are required to fit the small diameter tubular body of the apparatus.

Attempts have been made to reduce noise by optimising the fan design, for any given diameter, whilst still retaining efficiency. Stators are used to improve air flow over the heating element and to reduce turbulence. Known designs of fan blades and stators do not however significantly reduce noise.

It is an object of this invention to provide a fan design and a stator design either alone or together to form a ducted axial flow fan unit which has reduced noise for a given motor speed.

According to a first aspect of this invention there is provided a multi-blade fan having overlapping trailing and leading edges between adjacent blades, the trailing edges of the blades progressing forwardly (in the direction of rotation) and outwardly from the hub, the leading edges of the blades extending mainly radially.

According to a second aspect of this invention there is provided a construction of stator positioned adjacent and downstream of a fan, the stator comprising a plurality of vanes which extend from a central hub to an outer shroud or duct, the vanes, from a downstream to an upstream end, extending mainly parallel to the air flow then curving in a direction opposed to the fan rotational direction to extend generally parallel to the plane of the fan and to terminate in an edge defining the entrance for air flow from the fan into the duct. Preferably the edge is angled from a radial to extend from hub to shroud in a direction against the fan rotation.

The stator hub will preferably house the electric motor driving the fan.

A third aspect of this invention embodies the fan and stator in combination. This invention also embraces a hair drying apparatus including the aforesaid fan or fan unit and with an electric heating element downstream of the fan and an electric motor driving the fan, all being housed within a substantially cylindrical tubular body with an air inlet at

one end and an air outlet nozzle at the other end.

In order to enable the invention to be more fully understood an embodiment of both aspects of the invention is described by way of example only and with reference to the accompanying drawings, wherein:

Figure 1 shows an assembled motor, stator and fan in side view, the shroud or duct being omitted here,

Figure 2 shows a view as Figure 1 but from an end,

Figure 3 shows a view in perspective from the other end of the stator only,

Figure 4 shows an end plan view as in Figure 3,

Figure 5 shows the stator assembled to the duct in end view, but with the fan removed from the drive shaft, and

Figure 6 shows the fan only in rear view.

Referring generally to the drawings, these show only the stator, motor and fan or impeller which in use are contained within a tubular body forming a shroud which also includes an electrical resistance heater element. The embodiment illustrated is particularly for a domestic hair dryer having an element of up to 1,000 watts rating.

The construction of the fan 1 according to the invention includes five blades 2 of which the adjacent trailing and leading edges 3, 4 overlap with the trailing edge of a blade having a marked forward rake at the periphery as viewed in the direction of rotation as illustrated by arrow A in Figure 5. The fan is driven by a DC high speed motor 5 which is housed within the hub 6, having a plurality of outwardly extending vanes 7 which connect with the inner peripheral surface 8 of a shroud or body.

Each of the vanes commencing at the downstream end 10 of the flow extends generally parallel to the air flow towards the fan and thereafter curves at 11 in a direction against the rotational direction of the fan. A smoothly radiused curve 11 is provided with the end of the vane being defined by an edge formed by a portion 12 which generally extends in a direction parallel to the plane of the fan. This edge extends outwardly from a hub towards the shroud in a direction which lies at an angle B against the direction of rotation (see Figure 5). This edge of the vane in conjunction with the opposite angle of the trailing edge 3 of a fan blade forms an intersection which, as the fan rotates, progresses from the outer periphery of the vane and fan blade towards the hub. This is one feature in the construction which significantly reduces noise.

Noise is also reduced by the curvature of the vanes although if the portion extending parallel to the plane of the fan is too great then efficiency falls to an unacceptable level.

Whilst known constructions of impeller as-

embodies do include static vanes these are generally of planar construction and angled with respect to the longitudinal axis of the motor. In contrast the present invention includes vanes which are longer than known constructions and which include the curved portion adjacent the impeller whereby the angle of the vane at any point is not constant relative to the longitudinal axis.

- 10 In the preferred embodiment the assembly of hub and vanes will comprise a moulding which locates within the shroud 9 and which may be secured thereto by adhesive. Alternatively the shroud and vanes with the hub may be one single moulding with the central hub cavity receiving the motor. In order to further reduce noise there may be provided between the outer periphery of the motor body and the inner periphery of the hub a foam rubber or the like material serving to reduce transmission of vibration and hence noise to the body structure. The number of vanes and blades on the fan may be varied from that shown and furthermore the overlapping configuration of the leading and trailing edges of adjacent fan blades may be modified so that the construction may be more readily injection moulded in a two part mould.

- 30 Further and other preferred features in the construction are illustrated by the accompanying drawings and the invention furthermore contemplates a construction of hair dryer or similar appliance which incorporates the aforesaid assembly comprising the vanes and impeller or fan.

#### CLAIMS

1. A multi-blade fan having overlapping trailing and leading edges between adjacent blades, the trailing edges of the blades progressing forwardly (in the direction of rotation) and outwardly from the hub, the leading edges of the blades extending mainly radially.
2. A fan unit comprising a multi-blade fan in operative combination with a stator positioned adjacent and downstream of a fan, the stator comprising a plurality of vanes which extend from a central hub to an outer shroud or duct, the vanes, from a downstream to an upstream end, extending mainly parallel to the air flow then curving in a direction opposed to the fan rotational direction to extend generally parallel to the plane of the fan and to terminate in an edge defining the entrance for air flow from the fan into the duct.
3. A fan unit according to Claim 2, wherein the edge is angled from a radial to extend from hub to shroud in a direction against the fan rotation.
4. A fan unit comprising a multi-blade fan having overlapping trailing and leading edges between adjacent blades the trailing edges of the blades progressing forwardly (in the direction of rotation) and outwardly from the hub, the leading edges of the blades extending

mainly radially, the fan being in operative combination with a stator positioned adjacent and downstream of a fan, the stator comprising a plurality of vanes which extend from a central hub to an outer shroud or duct, the vanes, from a downstream to an upstream end, extending mainly parallel to the air flow then curving in a direction opposed to the fan rotational direction to extend generally parallel to the plane of the fan and to terminate in an edge defining the entrance for air flow from the fan into the duct.

5. A fan unit in accordance with Claims 2 or 3 or 4, wherein the central hub houses an electric motor serving to drive the fan.

6. A fan or fan unit according to any preceding claim wherein the leading edges of the fan blades extend forwardly in the direction of rotation from the hub towards the periphery.

7. A fan unit according to any one of Claims 2 to 6, wherein the edge of the vane in conjunction with the opposite angle of the trailing edge of a fan blade forms an intersection which, as the fan rotates, progresses from the outer periphery of the vane and fan blade towards the hub.

8. A multi-blade fan as described herein with reference to the accompanying drawings.

9. A stator for a fan unit as described herein with reference to the drawings.

10. A hair drying apparatus embodying the fan or fan unit according to any preceding claim, an electric heating element downstream of the fan and an electric motor driving the fan, all being housed within a substantially cylindrical tubular body with an air inlet at one end and an air outlet nozzle at the other end.

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